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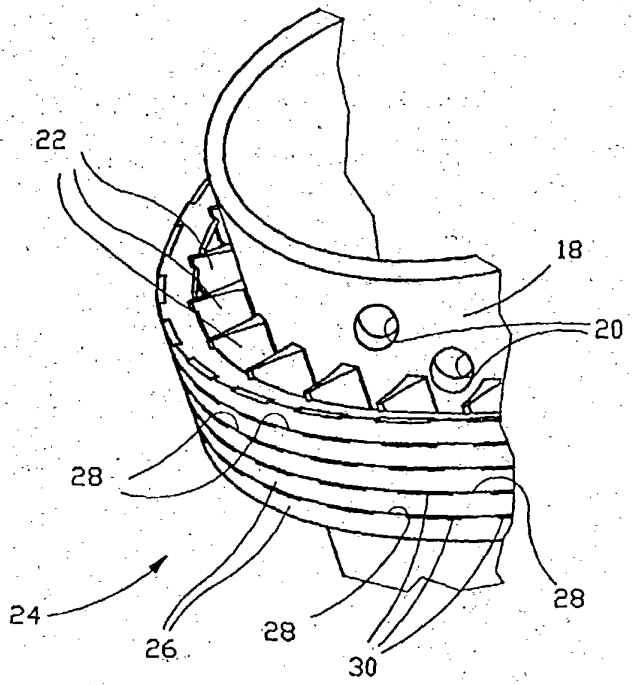
(54) Title: SANDFILTER DEVICE FOR USE IN THE RECOVERY OF OIL, GAS AND WATER

(57) Abstract

An account is given of a tubular sand filter for use in connection to water, gas and oil recovery, and shaped to let water/oil, but not sand particles, through radially through–going slots which outermost are shaped between thread windings (26) of which the outer, tubular screen body (24) of the sand filter is built up. In order to achieve a higher mechanical strength, said winding–forming thread is shaped with edge cavities distributed in the longitudinal direction thereof and becoming length–restricted slots (30) in the tubular condition of the screen body (24). Opposing side face portions (28) of adjacent thread windings (26) rest supportingly against each other, said resting force is directed in the longitudinal axial direction and contributes to increase the mechanical strength properties of the sand filter.



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SANDFILTER DEVICE FOR USE IN THE RECOVERY OF OIL, GAS AND WATER

This invention relates to sand filters/screens of the kind shaped and designed with a view of retaining sand particles, etc., but letting through water/oil when in the course of recovering water or petroleum deposits. The sand filter or sand screen comprises, preferably, an inner perforated pipe which, through spacer means, is attached to an outer, annular screen body assembled of annular, appropriately profiled threads, preferably in the form of a thread wound or coiled, following a helical course around the inner pipe leaving intermediate, through-going slots along the pipe wall.

In known sand filters of the kind concerned, said threads have a solid, polygonal, e.g. triangular, cross section, and the thread windings are placed laterally of each other with a certain spacing therebetween, said spacing - from a radially outer minimum distance where a very narrow inlet slot is formed, for e.g. oil from the surrounding formation in the reservoir, to an outlet slot for oil at the pipe body's inner jacket face. The outer inlet slot is so narrow that sand

particles and other undesired particles which may accompany the oil, are prevented from entering the sand filter.

In known profiled threads for this purpose, the cross-sectional shape has a circumference corresponding to an isosceles triangle having a relatively short base line in relation to the sides, so that the angle at the apex is about 30°, and the apex corner itself is somewhat rounded.

During the making of these tubular sand filters, the inner perforated pipe is rotated during the helical winding of the profiled thread which, a plurality of times per thread winding, is welded firmly to the free outer end edges of said spacer means in the form of longitudinal moulds.

These sand filters can function satisfactorily at vertical bore holes, even if they do not exhibit the optimally desired strength properties.

However, upon deviation drilling, especially upon starting deviation drilling from a lined vertical bore hole, the weaknesses of these known sand filters in respect of strength appear.

When drilling a deviation hole with a starting point in a vertical bore hole where casing is set and firmly cemented, a wedge-shaped, upwardly tapering guide body for the bit to be used for the drilling of the deviation hole, is lowered down in the bore hole.

In a starting phase of the deviation drilling proper, during said wedge body's guiding influence, a special bit cuts

itself through the casing, making an elongate hole therein. The hole in the casing will leave a sharp edge on which the wound screen body of the sand filter may get hooked, so that a longitudinal portion of the sand filter is destroyed, the annular threads being pressed against each other at one local portion, their intermediate slots opening up and forming irregularly large screen openings where sand particles later easily may pass when the well is set in production.

In order to counteract this disadvantageous effect in deviation drilling and other drilling, often, in accordance with known technique, a perforated sleeve is placed outside the sand filter. This screen sleeve can, indeed, to some extent reduce said disadvantages through a strengthening of the sand filter in relation to e.g. said casing hole but introduces, thus, other problems.

This known outer screen sleeve surrounding the inner screen pipe of the known sand filter, is also sensible to the risk of damage represented by the sharp hole edge in the casing and, furthermore, the screen sleeve causes the clear disadvantage of increased weight and width dimension being added to the sand filter. Such sand filters may be rather long, e.g. from 500 to 1500 meters, and said weight increase may be quite substantial.

Therefore, an important object of the invention has been to provide a sand filter of the kind concerned which resists external influences of an entirely other order than known sand filters of corresponding dimensions.

The object is realized in that a sand filter in accordance with the preamble of claim 1 is shaped and designed such that

it exhibits the distinctive features as defined in the characterizing clause of claim 1.

According to the invention, the profiled thread is formed with cut out side portions, each such cavity (cut out portion) extending along a fraction of a thread winding, so that - when the opposed sides of the thread windings (radially) outermost are placed resting against each other - slots will be formed; the slots may, but do not have to, be aligned with each other in the longitudinal and/or lateral direction of the screen pipe. The radially through-going, local slots formed during the winding of the screen thread, may e.g. be ordered in rows in the circumferential direction of the screen body, the rows being displaced parallelly in relation to each other, slopingly orientated in relation to the pipe axis of the screen body. A typical slot aperture may be 0.2 - 0.4 millimeters.

The mechanical strength of a sand filter built up on such an outer screen body is substantially larger than the one of known and conventional sand filters, and this is due to that the thread windings extending along a helical course, rest supportingly against each other along a substantial portion of their longitudinal extent, i.e. in the circumferential direction of the screen body. Due to manufacturing-technical causes, there may exist 1/100 millimeter spacing intermediate the thread windings.

According to the present invention, in a thread cross section substantially corresponding to an isosceles triangle, it will be advantageous to form the cross section so that it closest to the base line exhibits two parallel, straight side portions, forming longitudinal shoulder portions of the

profiled thread. In this profiled thread, the longitudinal edge cavities are formed in one or both shoulder portions, while the portions intermediate the edge cavities will rest against the neighbour shoulder portions, allotting the outer screen body of the sand filter a substantial mechanical strength.

When such a sand filter is subjected to external forces, e.g. pressure or tensile forces, mutually adjacent thread windings, between said slots, support each other, and this mutual support propagates across the entire longitudinal section undergoing stresses.

Said substantially isosceles triangle cross section having substantially parallel side portions outermost, is not critical for the achievement of the function and object of the invention. Thus, other cross-sectional shapes of the profiled thread may be considered, e.g. having circular circumference.

Non-restricting examples of exemplary embodiments of the invention are explained in the following, reference being made to accompanying drawings, wherein:

Figure 1 shows a vertical section through a formation in which, through a vertical bore hole with casing, by means of a special bit, a deviation hole has been drilled, whereby an elongate hole in the casing has been formed;

Figure 2 shows, on a larger scale, a partial perspective view of a sand filter having an outer tubular screen body built up of profiled thread according to the invention, welded to

outer ends of radial spacers known per se and resting with their inner ends against a perforated pipe;

Figure 3 corresponds to figure 2, but shows a variant of a sand filter without perforated inner pipe;

Figure 4 shows in side elevation view a short longitudinal portion of the outer tubular screen body of a sand filter;

Figure 5 shows a section from figure 4, on a larger scale;

Figure 6 corresponds to figure 4, but shows another positioning of the rows of through-going slots aligned in the circumferential direction;

Figures 7-11 each shows lateral cross-section through four adjacent thread windings, in each single case formed in accordance with the present invention, in that

Figure 7 shows four adjacent thread windings included as outer tubular member in a sand filter of the kind concerned, wherein the thread cross section, except from the edge cavities according to the invention, is of a known type;

Figure 8 corresponds to figure 7, but shows another thread cross section in accordance with the sectional line VIII - VIII in figure 5;

Figure 9 corresponds to figure 8, but shows another thread cross section, especially at the radially outer face which, here, is slightly rounded;

Figure 10 shows the same thread cross section as figure 8, but here the section is positioned at X - X in figure 5, so that the slot-forming edge cavities can not be seen; on the other hand, it appears that opposing side face portions (shoulder portions) of adjacent thread windings are resting supportingly against each other, confer figure 4; and

Figure 11 illustrates a usable, but less actual thread cross section, namely circular.

Figure 12 corresponds to figure 10, but shows a section on a significantly larger scale.

Reference is made to the drawings, first to figure 1 which in a layout view illustrates a portion of a well in which sand filters of the kind concerned may be subjected to great strains.

In a vertical bore hole 10, a casing 12 is set and firmly cemented. Within the latter, a long, narrow wedge has been driven, the wedge tapering in an upward direction, serving as a guiding body when drilling a deviation hole 14. The deviation drilling is carried out with a special bit which will make a very elongated hole in the casing. The length of the casing hole in the vertical direction is indicated at 16.

The edges of the casing around the longitudinal hole traditionally create great strains in the sand filter when it is passed through the hole aperture. Particularly the outer tubular screen body of the filter built up of said spun/wound thread having through-going inlet slots along its entire winding length, so that the thread windings are forced out of

their intended positions, opening some intermediate inlet slots in such a degree that sand particles later can flow therethrough.

Figures 2 and 3 shows perspective views of a short portion of the general constructive assembly of such sand filters.

Often, such a sand filter comprises an inner pipe 18 formed with radially through-going holes 20. Onto the perforated inner pipe 18 is externally disposed a number of radial/axial spacers 22 in the form of short, longitudinal moulds distributed equidistantly in the circumferential direction of the inner pipe 18. E.g., 20 such spacer moulds 22 may be disposed equidistantly around the axis of the sand filter. The spacer moulds and the later to be mentioned, outer, tubular screen body consist of materials/metals weldable to each other. The way of joining is not subject matter for this invention; neither the shape or design of the perforated inner pipe 18 or the spacer moulds 22.

The outer, tubular screen body 24 is built up of 360° extending windings of profiled thread 26.

Here, reference is temporarily made to figures 8 and 10, showing as preferred embodiment of profiled thread 26, here represented by the cross-sectional shape of the thread 26b.

The main shape of this cross section is a isosceles triangle where the side portions 28b positioned closest to the base line are substantially parallel, see especially figure 10 where the section X - X in figure 5 is placed outside the

circumferentially broken, slot- forming edge cavities 30b, figure 8.

Side portions 28 in figures 2 and 3 form circular shoulders broken by slots 30 formed of edge cavities 30a, figure 7.

In figures 4 - 6, the same reference numerals as in figures 2 and 3 are kept.

It should appear that opposing side face portions of adjacent thread windings are disposed rather resting supportingly against each other in the circumferential direction of the sand filter, only interrupted by the edge cavities 30, which gives the screen body 24 significant mechanical strength properties.

According to figure 6, the slots 30 in relation to figures 4 and 5 are placed such that they are not aligned in the longitudinal axial direction of the tubular sand filter 18,22,24, but are parallel displaced row by row.

Finally, reference is made to figures 7 - 11 showing some various thread cross-sectional shapes.

In figure 7, which otherwise represents an ordinary thread cross section, edge cavities/slots 30a are formed, e.g. placed and distributed as indicated in figures 2 and 3 for the slots 30.

According to figure 9, each of the outer faces 32 of the thread windings has a certain curvature in the circumferential direction. Sand filters having such a surface

will easier slide along pipe walls/formations for wells/edges, etc.

Figure 10 (section X - X in figure 5) shows the same cross-sectional shape as figure 8 section VIII - VIII in figure 5) and illustrates the large land faces of opposing thread side portions which rest against each other in this embodiment.

Figure 12 shows the same cross-sectional shape as figure 10, but on a significantly larger scale, and illustrates that between two thread windings 28b, a very narrow slot 29 exists between opposing side face portions. The spacing 29 is due to the production process which often does not allow that the thread windings 26b rest directly supportingly against each other. Typically, the distance between the thread windings 29 may be 1/100 millimeters.

The outer tubular screen body of the sand filter may, following a known method, be formed by one single thread which, during the rotation of the inner pipe 18, is spun/wound around it helically, adjacent shoulder portion faces 28 on the thread windings 26 (between the slots 30) resting approximately supportingly against each other, during continuous welding onto the outer ends of the spacer moulds 22.

As soon as the thread is wound helically with mutually opposing and side portions resting against each other, forming a tight-fitting spiral form, these edge cavities are converted into closed slots 30, see e.g. figures 2 and 3.

The edge cavities may be cut out, e.g. milled out, just before the thread 26 is welded to the spacer moulds 22. Alternatively, the thread 26 may be prefabricated including the desired edge cavities.

An advantageous, but subordinate and, thus, not critical feature consists in that the radial extent of the edge cavities 30 is longer than the radial extent of the shoulder portions 28. It appears from figures 8 and 9 that the edge cavities 30b and 30c, respectively, in both cases have a radial extent exceeding the shoulder portions 28b and 28c, respectively, in the same direction.

The edge cavities forming the slots 30 widen inwardly in radial direction, so that a sand granule which in the first place has passed in through the inlet portion of the slot 30, is not allowed to get wedged.

Claims

1. A sand filter shaped with lateral admission slots through an external pipe wall, wherein the admission slots are formed between thread windings (26) in an outer, tubular screen body (24) included in the sand filter and which may be attached to an inner, perforated pipe (18), e.g. through intermediate spacer means (22), characterized in that said thread (26) in the windings forming the outer, tubular screen body (24), on at least one longitudinal side, is shaped with interrupted and distributed edge cavities extending in the thread's longitudinal direction and which, in the screen body (24), form corresponding, length-restricted slots (30) which, in the circumferential direction, each extends along a smaller part thereof only, and that opposing side face portions (28) of adjacent thread windings (26) between the slots (30) are spaced so insignificantly from each other in the longitudinal axial direction of said tubular screen body (24) that they immediately will come resting supportingly against each other when the sand filter is subjected to external forces of influence.

2. A tubular sand filter shaped in accordance with claim 1, wherein said thread windings (26) are formed by one helically wound, profiled thread having a cross section substantially as an isosceles triangle, characterized in that thread side face portions at opposite sides of an isosceles triangle's base line in the thread cross section have a substantially mutually parallel course, thus forming opposite shoulder portions (28b, 28c) extending in the

longitudinal direction of said thread and carrying said side face portions.

3. A tubular sand filter shaped in accordance with claim 2, characterized in that the edge cavity (30) with which said thread (26) is shaped, at one or both opposite, longitudinal side edges, has a larger radial extend than each of said shoulder portions (28b, 28c).

4. A tubular sand filter shaped in accordance with claim 1, 2 or 3, characterized in that the face (32) of said thread which becomes directed radially outwardly, has a convex curvature.

5. A tubular sand filter shaped in accordance with one or more of the preceding claims, characterized in that each of the slots (30) widens radially in an inward direction.

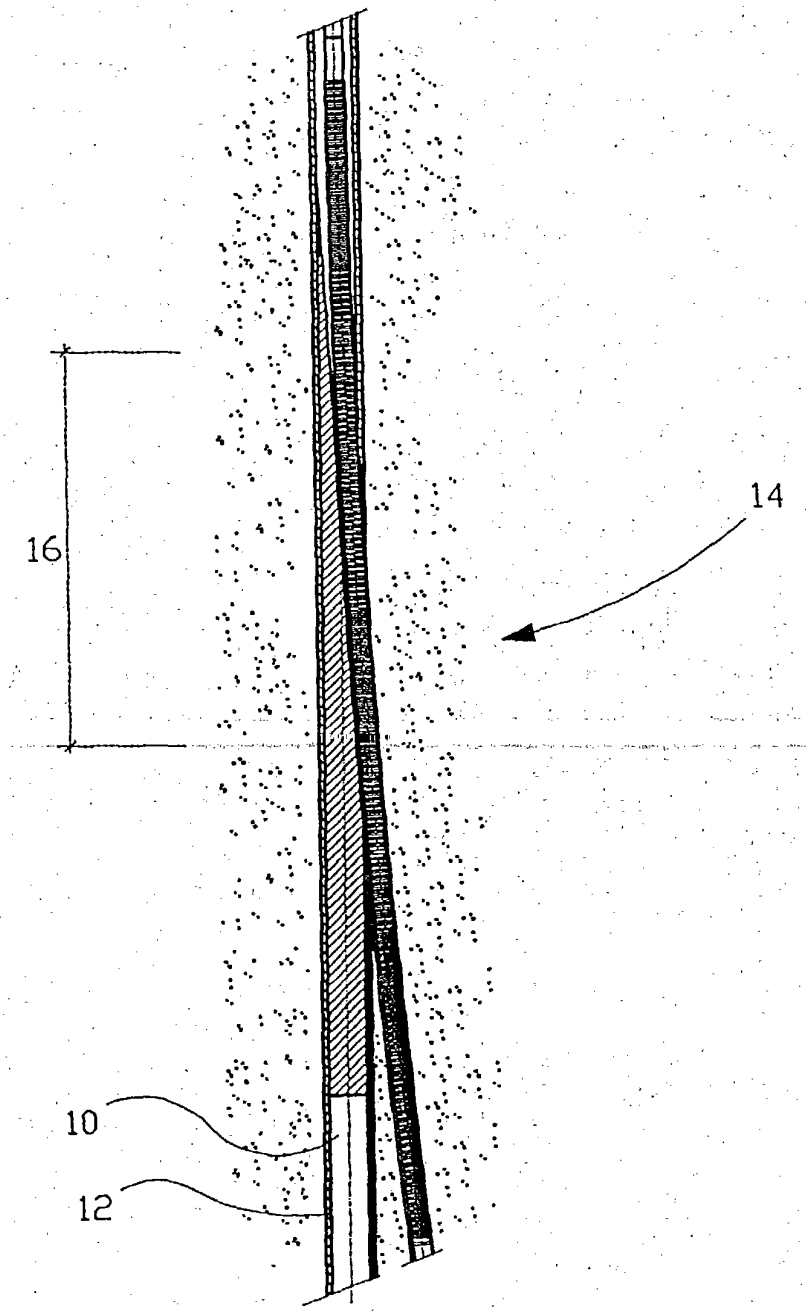

FIG. 1

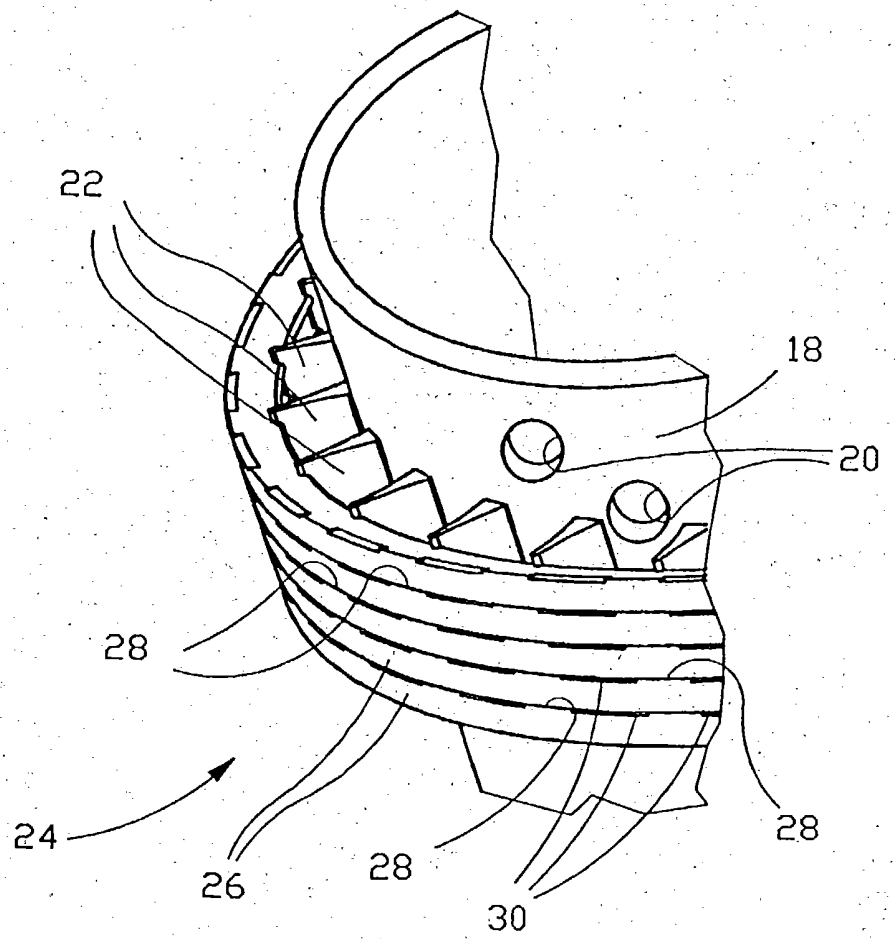

FIG. 2

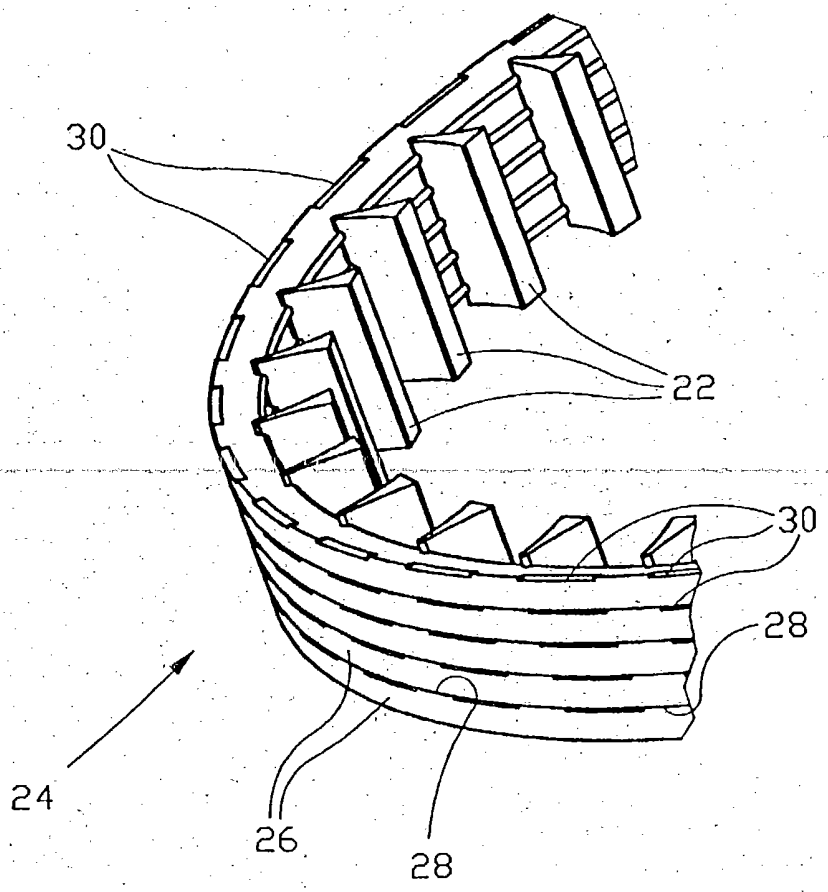

FIG. 3

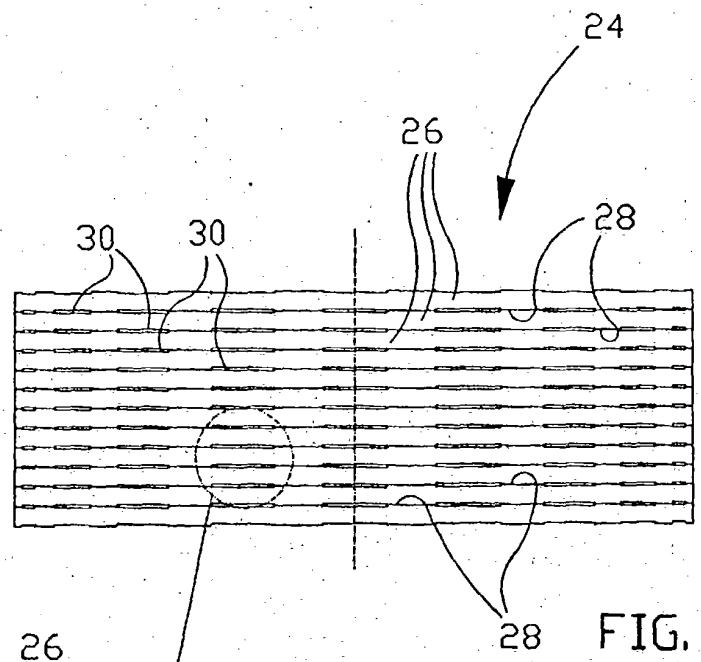

FIG. 4

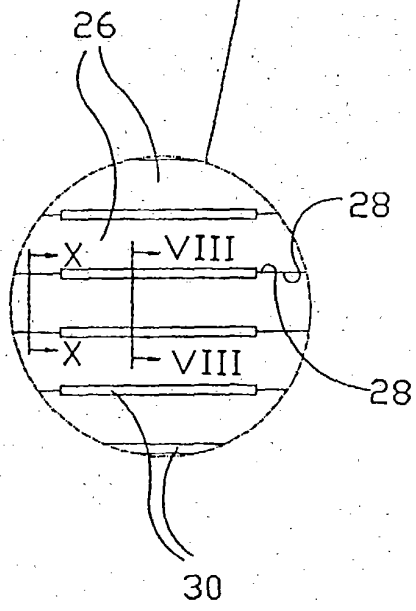

FIG. 5

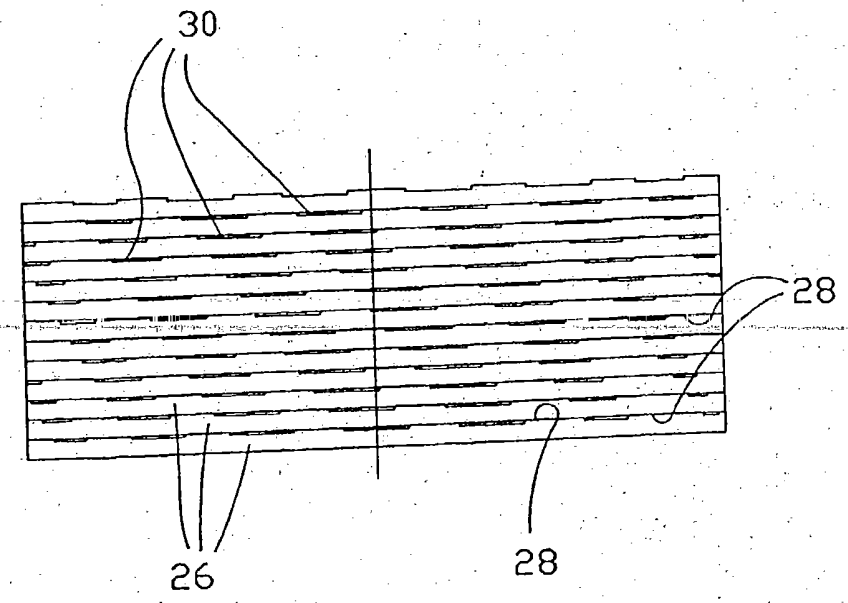

FIG. 6

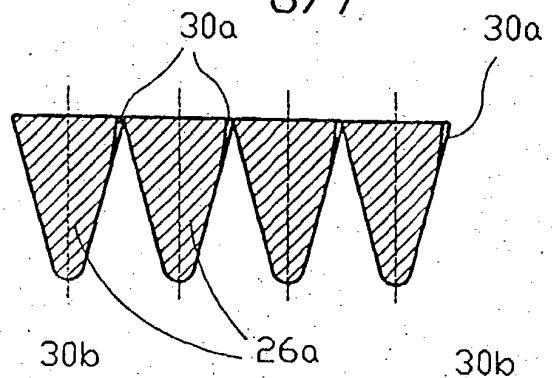

FIG. 7

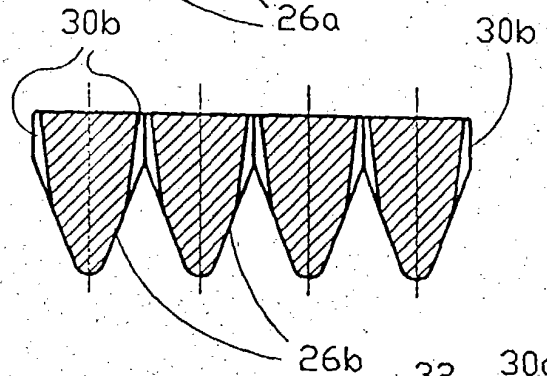

FIG. 8

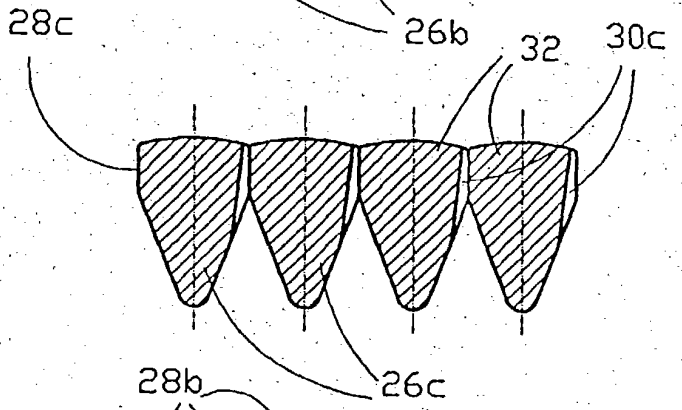

FIG. 9

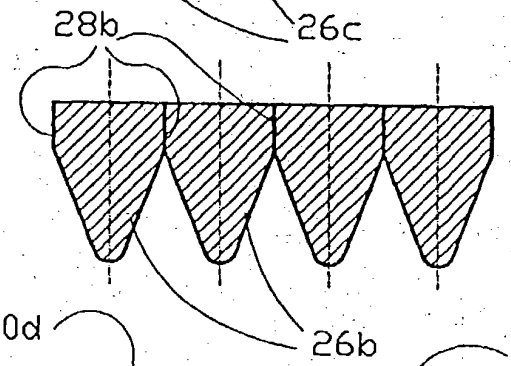

FIG. 10

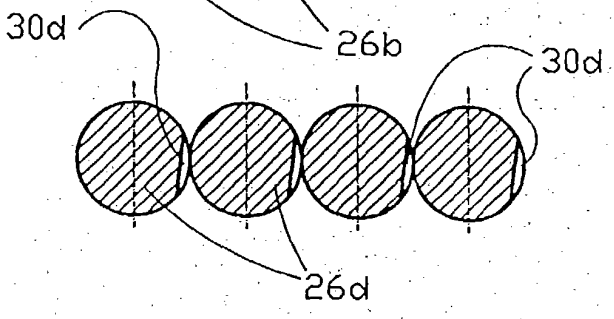

FIG. 11

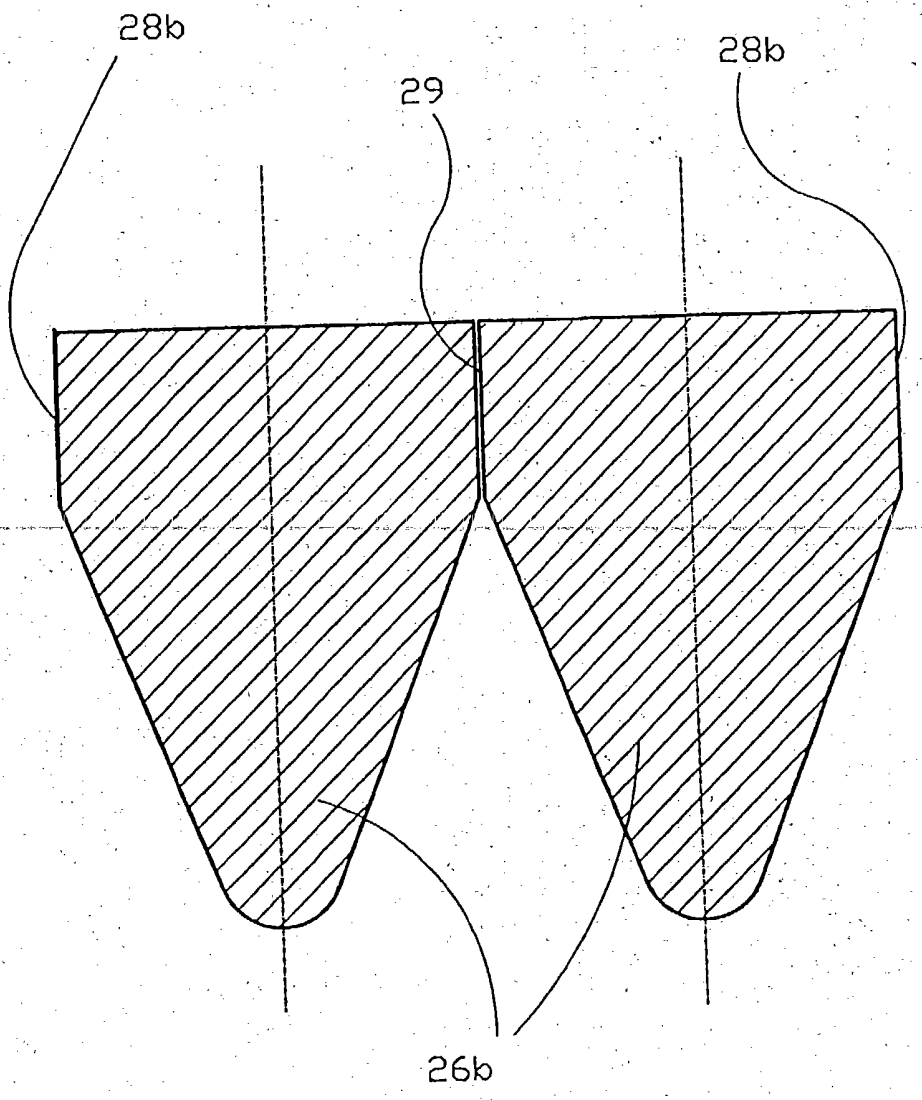

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00037

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E21B 43/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 1845265 A (F.I. GETTY), 16 February 1932 (16.02.32), the whole document --	1,2,4
X	US 3709293 A (L.A. LAYNE, II ET AL), 9 January 1973 (09.01.73), the whole document --	1

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 May 2000	23 -05- 2000
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00037

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

02/12/99

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